MINISTRY OF EDUCATION AND SCIENCE OF THE RUSSIAN FEDERATION
Federal state autonomous educational institution
of higher education
«Far Eastern Federal University»
(FEFU)

INSTITUTE OF LIFE SCIENCES AND BIOMEDICINE (SCHOOL)

AGREED

Head of OP

Kalenik T.K.
(signature) (full name)
«28» September 2021 г.

APPROVE

Head of VSP

Kalenik T.K.
(signature) (full name)
«28» September 2021 г.

WORKING PROGRAM OF THE DISCIPLINE

Enzymatic and microbial conversion

Direction of training 19.04.01 «Biotechnology»
(«Agri-Food Biotechnology»)
Form of training full-time

course 1 semester 1
lectures 18 hours.
practical classes 36 h.
laboratory work 0 hours.
including using
total classroom hours 54 hours.
independent work 9 h.
including preparation for the exam 45 hours (if the exam is provided).
control works (quantity) are not provided
term paper / term project are not provided
credit not included
exam 1 semester

The program of the state final certification was compiled in accordance with the requirements of the Federal State Educational Standard in the field of study 19.04.01 Biotechnology, approved by order of the Ministry of Science and Higher Education of the Russian Federation dated August 10, 2021 No. 737.

The program at the meeting of the Academic Council of the Institute of Life Sciences and Biomedicine (School) December 21, 2021
Director of the Department of Food Science and Technology Kalenik T.K.
Compiled by: Kim E.M.

Reverse side of the title page of the RPMU

I. The work program was revised at the meeting of the department:
Protocol dated «_____» _____ 20___ № _____
Director _____ _____
(signature) (full name)

II. The work program was revised at the meeting of the department:
Protocol dated «_____» _____ 20___ № _____
Director _____ _____
(signature) (full name)

III. The work program was revised at the meeting of the department:
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IV. The work program was revised at the meeting of the department:
Protocol dated «_____» _____ 20___ № _____
Director _____ _____
(signature) (full name)

ABSTRACT

Master's degree in 19.04.01 "Biotechnology"

Master's Program "Agri-Food Biotechnology"

Course title: «Enzymatic and microbial conversion»

Variable part of Block 1, 3 credits

Instructor: Ph.D. Yuferova A.A.

At the beginning of the course a student should be able to:

– the ability to use modern methods and technologies (including information) in professional activities;

– hold the basic methods and techniques of experimental research in the professional field; ability to carry out standard and certification tests of raw materials, finished products and production processes;

– possession of experimental design, processing and presentation of the results;

– the ability to participate in the development of technological projects in the group of authors;

– the ability to develop and implement normative documents on standardization, certification of food products.

Learning outcomes:

SPC-14 ability to use the model and to develop new methods of engineering calculation of process parameters and production of biotechnological equipment;

SPC-17 readiness for carry out the pilot development of the technology and zooming processes;

SPC-19 ability to analyze the performance of the process for compliance of the original scientific research.

Course description: Contents cover a range of issues related to the study of chemical, biotechnological and biological processes, biotechnological equipment, the problems of saving and rational use of resources, the latest achievements in the field of raw materials processing plant and animal origin, familiarization with the

process of enzymatic conversion and biotechnological equipment, carrying out these processes. Implementation of this program involves extensive use of students' knowledge gained in the study of previous disciplines.

Main course literature:

1. Microbiology / A. L. Ivchatov. Moscow: Publishing House of the Association of Construction Universities, 2013. - 118 p. (5 copies.) Http://lib.dvfu.ru:8080/lib/item?id=chamo:864427&theme=FEFU

2. Visual biotechnology and genetic engineering / R. Schmid; per. with him. A. A. Vinogradova, A. A. Sinyushina. Moscow: BINOM. Laboratory of Knowledge, 2014. - 324 p. (10 copies) http://lib.dvfu.ru:8080/lib/item?id=chamo:797469&theme=FEFU

3. Workshop on Enzymology / V.V. Sova, Yu.V. Burtseva; Far Eastern State University, Institute of Chemistry and Applied Ecology, Pacific Institute of Bioorganic Chemistry of the Far East Branch of the Russian Academy of Sciences. Vladivostok: Far Eastern University Publishing House, 2010. - 31 p. (9 copies.) Http://lib.dvfu.ru:8080/lib/item?id=chamo:298293&theme=FEFU

Form of final knowledge control: exam.

1. Purpose and objectives of mastering the discipline:

The purpose of mastering the discipline «Enzymatic and microbial conversion» is the development of an integrated approach to the organization of biotechnological production, a detailed study of biotechnological processes in the field of agriculture, biotechnological production based on plant and animal raw materials.

Objectives of the discipline:

– the study of scientific and technical information, domestic and foreign experience in the field of biotechnological industries, biotechnology of food products;

– the development of concepts for the implementation of biotechnological processes, the study of the stages of processes, their scientific foundations.

As a result of studying this discipline, the following professional competencies (elements of competencies) are formed in students.

Код и формулировка компетенции	**Этапы формирования компетенции**	
SPC-14 the ability to use standard and develop new methods for engineering calculations of technological parameters and equipment for biotechnological production	Knows	typical and new methods of engineering calculations of technological parameters and equipment of biotechnological productions
	Can	use standard and develop new methods for engineering calculations of technological parameters and equipment for biotechnological production
	Owns	skills in using standard and developing new methods for engineering calculations of technological parameters and equipment for biotechnological production
SPC-17 readiness for pilot testing of technology and scaling of processes	Knows	pilot testing of technology and scaling of processes
	Can	conduct pilot testing of technology and scaling of processes
	Owns	skills in conducting pilot testing of technology and scaling up processes
SPC-19 the ability to analyze the indicators of the technological process for compliance with the original scientific developments	Knows	analysis of process indicators for compliance with initial scientific developments
	Can	analyze the indicators of the technological process for compliance with the original scientific developments
	Owns	the skills of analyzing the indicators of the technological process for compliance with the original scientific developments

2. The complexity of the discipline and types of training sessions in the discipline

The total labor intensity of the discipline is 4 credit units (144 academic hours).

The types of training sessions and work of the student in the discipline can be:

Designation	Types of training sessions and work of the student
Lec	Lectures
Lab	Labs
Pe	Practical exercises
Oc	Online course
SR	Independent work of the student during the period of theoretical training
Control	Independent work of the student and contact work of the student with the teacher during the period of intermediate certification

Discipline structure:

The form of education is full-time.

№	Section name disciplines	Semester	The number of hours by type of training sessions and work of the student						Forms of intermediate certification, current monitoring of progress
			Lec	Lab	Pe	Oc	SR	Control	
1	Section I. Plant and animal raw materials used in biotechnological processes	1	6	0	18		9	45	exam
2	Section II. Methods for the conversion of plant and animal raw materials	1	12	0	18				exam
	Total:		18	0	36		9	45	

3. STRUCTURE AND CONTENT OF THE THEORETICAL PART OF THE COURSE

Section I. Plant and animal raw materials used in biotechnological processes

Topic 1. Cellulose-containing and pentosan-containing raw materials Classification and sources of raw materials. The anatomical structure of plant cells of cellulose-containing and pentosan-containing raw materials. The chemical composition of cellulose-containing and pentosan-containing raw materials.

Topic 2. Starch-containing raw materials. Sugar-containing raw materials.

The anatomical structure of the grain. The chemical composition of grain and sugar materials.

Topic 3. The concept of conversion and bioconversion of plant and animal raw materials

The concept of conversion and bioconversion. Types of bioconversion. Waste-free technologies for the use of plant and animal raw materials.

Section II. Methods for the conversion of plant and animal raw materials

Topic 1. Methods of conversion of plant and animal raw materials Classification of conversion methods of plant and animal raw materials. Theory of hydrolysis of polysaccharides of plant materials. The theory of the processes of fermentation of microorganisms on substrates from plant materials.

Topic 2. Lecture-discussion: «Bioconversion of raw materials of plant origin»

During the lecture-discussion, the teacher gives individual examples in the form of situations or briefly formulated problems, respectively, students analyze and discuss specific situations and material. The teacher, when presenting the lecture material, uses students' answers to their questions and organizes a free exchange of views in the intervals between logical sections.

Questions of the lecture: bioconversion of carbohydrate-containing raw materials of plant origin; protein bioconversion; lipid bioconversion.

Topic 3. Obtaining dietary supplements by the conversion of plant materials

Bioconversion of low molecular weight biologically active substances that make up plant and animal raw materials.

Topic 4. Physical and combined methods of conversion of plant and animal raw materials

Mechanical and mechanochemical destruction of plant and animal raw materials. Radiolysis of plant and animal raw materials. The effect of ultrasound on raw materials.

Topic 5. Chemical methods of conversion of plant and animal raw materials

Hydrolysis of raw materials with dilute acids. Conversion of cellulose-containing and pentosan-containing raw materials with concentrated acids. Hydrolysis of cellulose-containing and pentosan-containing raw materials with salt catalysts. Hydrolysis of cellulose-containing and pentosan-containing raw materials with gaseous reagents.

Topic 6. Lecture-discussion: «Biological methods of conversion of plant and animal raw materials»

During the lecture-discussion, the teacher gives individual examples in the form of situations or briefly formulated problems, respectively, students analyze and discuss specific situations and material. The teacher, when presenting the lecture material, uses students' answers to their questions and organizes a free exchange of views in the intervals between logical sections.

Questions of the lecture: bioconversion of plant and animal raw materials with enzymes; direct bioconversion of plant and animal raw materials by microorganisms; bioconversion of plant and animal raw materials by enzymes and microorganisms.

4. STRUCTURE AND CONTENT OF THE PRACTICAL PART OF THE COURSE

Practical classes (36 h.)

Lesson 1. Seminar on the topic: «The chemical composition of living organisms»

1. Physiological functions of the most important chemical elements.

2. The chemical composition of the cells of living organisms.

3. Cell nutrition elements used in biotechnological production.

4. The main substrates used in the production of biological products, and the resulting products.

Lesson 2. Round table (MAO) on the topic: «Production and industrial use of enzymes»

To participate in the discussion of the topic of the round table, students should be familiar with the methods of obtaining and the basics of the use of enzymes in various industries, concepts and terminology of this field.

The round table is aimed at consolidating the knowledge gained by students, as well as the ability to conduct a discussion.

Points for discussion:

1. Proteolytic enzyme preparations.

2. Pectolytic enzyme preparations.

3. Cellulolytic enzyme preparations.

Lesson 3. Seminar on the topic: «Structure and general properties of enzymes»

1. The mechanism of action of enzymes. Kinetics of enzymatic catalysis.

2. The effect of temperature and pH on enzyme activity.

3. Regulation of enzyme activity.

4. Classification, nomenclature and methods for determining the activity of enzymes.

Lesson 4. Round table (MAO) on the topic: «Bioconversion of food raw materials using enzymes»

To participate in the discussion of the topic of the round table, students should be familiar with the processes of enzymatic conversion of food raw materials, concepts and terminology in this area.

The round table is aimed at consolidating the knowledge gained by students, as well as the ability to conduct a discussion.

Points for discussion:

1. The use of enzyme preparations in the food industry.
2. Enzyme preparations used in the confectionery industry.
3. The production of alcoholic beverages using bioconversion.
4. Wines: grape and fruit. Receiving.
5. The production of soft drinks.

Lesson 5. «Analysis of plant materials and products of its bioconversion»

1. Technological analysis of plant feed.
2. Types of plant foods with high nutritional value.
3. The process of silage feed.
4. Factors affecting the quality of the silo.
5. Methods for determining the moisture content of feed and grain raw materials.
6. Aokazatel Feed units.
7. The indicator Exchange energy.

Lesson 6. Determination of ash content of grain

1. Grain components characterizing its ash content.
2. Convertible component of grain.
3. The mechanism of the process of lignification of plant materials.
4. The main plant waste agricultural.
5. Methods of microbial use of mineral elements in the bioconversion of plant materials.

Lesson 7. Determination of carotene in feed

1. Biologically active components of plant materials.
2. The importance of volatile production for plants and humans.
3. Examples of plant foods high in carotene.

4. The effect of the ratio of organic acids in the composition of the silo on its quality.

5. Known carotene isomers.

6. The essence of the method for determining carotene in feed.

Lesson 8. Determination of phosphorus content in feed

1. The main macroelements of plant feed.

2. Nitrogen nutrition of plants at various periods of its growth.

3. Examples of mineral fertilizers.

4. Bioconversion products of plants with a high content of potassium.

5. The role of phosphorus in the development of microbial and plant cells.

6. The essence of the method for determining phosphorus in feed.

Lesson 9. Seminar on the topic: Getting biodegradable packaging from starch

1. The definition of "biodegradation".

2. Types of recycling from plastic.

3. Types of biodegradable polymeric materials.

4. The essence of the method of obtaining biodegradable packaging from starch.

Lesson 10. Seminar on the topic: Determination of cellulolytic activity of soil microorganisms

1. Characterization of cellulose as a raw material for bioconversion.

2. Types of decomposition of cellulose.

3. Characterization of microorganisms involved in the aerobic decomposition of cellulose.

4. Characterization of microorganisms involved in anaerobic decomposition of cellulose.

5. Biochemical processes occurring during the hydrolysis of cellulose.

Lesson 11. Seminar on the topic: Evaluation of the microbial decomposition of pectin substances

1. Characterization of pectin.

2. Features of pectin-degrading microorganisms.

3. Characterization of hemicellulose.

4. Features of the decomposition of hemicellulose.

5. Characterization of lignin.

6. Features of the decomposition of lignin.

Lesson 12. Bioconversion of ethanol-containing wastes into acetic acid with acetic acid bacteria

1. The essence of the method of bioconversion of ethanol-containing waste into acetic acid by acetic acid bacteria.

2. Description of the analysis methods used and the formulas for their calculation.

3. Construction of a graphical dependence of the concentration of yeast cell biomass over time.

Lesson 13. Obtaining a soft drink during the cultivation of a complex of Kombucha microorganisms

1. The essence of the process of obtaining a soft drink when growing a complex of microorganisms of Kombucha.

2. Description of the analysis methods used and the formulas for their calculation.

3. Construction of a graphical dependence of the concentration of yeast cell biomass over time.

Lesson 14. Using a bioconversion medium to produce citric acid in the surface cultivation of microscopic fungi

1. The essence of the process of producing citric acid by surface cultivation of microscopic fungi.

2. Growing cell culture. The processes of cultivation of microorganisms.

3. Features of the cultivation of microscopic fungi.

4. Products of microbial fermentation and metabolism.

Lesson 15. The influence of the composition of the bioconversion medium on the accumulation of amylase during solid-phase cultivation of mycomycetes

1. The essence of the process is the accumulation of amylase during solid-phase cultivation of mycomycetes.

2. Preparation of bioconversion medium for solid-phase cultivation.

3. Features of the cultivation of microorganisms for the accumulation of amylase.

Lesson 16. Round table (MAO) on the topic: Study of the yeast process

To participate in the discussion of the topic of the round table, students should be acquainted with the basics of biotechnological processing of agricultural raw materials for feed purposes, the concepts and terminology of this field.

The round table is aimed at consolidating the knowledge gained by students, as well as the ability to conduct a discussion.

Points for discussion:

1. Technological features of the feed yeast process.

2. Features of opaque and unpaired methods of feed yeast.

3. Determination of the presence of living yeast cells.

4. Assessment of the total microbial contamination of yeast feed.

Lesson 17. Seminar on the topic: Getting bioethanol

1. The benefits of bioethanol.

2. The essence of the process of alcoholic fermentation.

3. Organisms involved in alcoholic fermentation.

4. Methods of reproduction of yeast.

5. The reaction products resulting from the fermentation of carbohydrates.

5. The concept of fermentation intensity.

6. Qualitative reactions for the detection of alcohol.

Lesson 18. Round table (MAO) on the topic: Biogas production

To participate in the discussion of the topic of the round table, students should be familiar with the methods of obtaining biofuels, concepts and terminology in this area.

The round table is aimed at consolidating the knowledge gained by students, as well as the ability to conduct a discussion.

Points for discussion:

1. The concept of "biogas".
2. The scheme for biogas production.
3. Sources of biogas.
4. Methane-forming bacteria and features of their cultivation.
5. Technological parameters of methanogenesis.
6. Current trends in methanogenesis.

5. TRAINING AND METHODOLOGICAL SUPPORT OF STUDENTS'S INDEPENDENT WORK

Educational and methodological support for the independent work of students in the discipline «Enzymatic and microbial conversion» is presented in Appendix 1 and includes:

- a schedule of independent work on the discipline, including approximate norms of time to complete each task;
- characteristics of tasks for independent work of students and guidelines for their implementation;
- requirements for the presentation and presentation of the results of independent work;
- criteria for evaluating the performance of independent work.

6. CONTROL OF ACHIEVING COURSE OBJECTIVES

№	Supervised sections / topics of discipline	Codes and stages of formation of competencies		Evaluation Tools	
				current control	intermediate certification
1	Section I. Plant	SPC-17	Knows methods for	UO-1 -	Exam

	and animal raw materials used in biotechnological processes		developing new and modifying existing biotechnological processes for obtaining end products	interview, UO-2 - colloquium, PR-4 - essay	Questions 1-30 Pr-1 - final test
			Able to apply methods for developing new and modifying existing biotechnological processes for obtaining final products		
			Owns methods for developing new and modifying existing biotechnological processes for obtaining end products		
2	Section II. Methods for the conversion of plant and animal raw materials	SPC-14; SPC-19	Knows how to organize and conduct the technological process within the framework of the technology for the production of biotechnological products adopted in the organization	UO-1 - interview, UO-2 - colloquium, PR-4 - essay	Exam Questions 31-72 Pr-1 - final test
			Able to apply methods of organizing and conducting a technological process within the framework of the technology for the production of biotechnological products adopted in the organization		
			Owns methods of organizing and conducting the technological process within the framework of the technology for the production of biotechnological products adopted in the organization		

Typical control tasks, methodological materials that determine the procedures for assessing knowledge, skills and (or) experience, as well as criteria and indicators necessary for assessing knowledge, skills, and characterizing the stages

of formation of competencies in the process of mastering an educational program are presented in the Appendix 2.

7. LIST OF TRAINING LITERATURE AND INFORMATION AND METHODOLOGICAL SUPPORT OF DISCIPLINE

Main literature

(electronic and print editions)

1. Microbiology / A. L. Ivchatov. Moscow: Publishing House of the Association of Building Universities, 2013. - 118 p. (5 copies) http://lib.dvfu.ru:8080/lib/item?id=chamo:864427&theme=FEFU

2. Visual biotechnology and genetic engineering / R. Schmid; trans. with him. A. A. Vinogradova, A. A. Sinyushina. Moscow: BINOM. Laboratory of Knowledge, 2014 .-- 324 p. (10 copies) http://lib.dvfu.ru:8080/lib/item?id=chamo:797469&theme=FEFU

3. Workshop on Enzymology / VV Sova, Yu. V. Burtseva; Far Eastern State University, Institute of Chemistry and Applied Ecology, Pacific Institute of Bioorganic Chemistry FEB RAS. Vladivostok: Publishing House of the Far Eastern University, 2010. - 31 p. (9 copies) http://lib.dvfu.ru:8080/lib/item?id=chamo:298293&theme=FEFU

Additional literature

(electronic and print editions)

1. The basic principles of processing raw materials of plant, animal, microbiological origin and fish: method. directions for students special. 240902 "Food biotechnology" of all forms of education / comp. E.V. Makarova, Vladivostok: Publishing House of the Pacific Economic University, 2009. - 80 p. (10 copies) http://lib.dvfu.ru:8080/lib/item?id=chamo:356130&theme=FEFU

2. Animal biochemistry: a textbook for high schools / VV Rogozhin, [St. Petersburg]: GIORD, 2009, 552 p. (9 copies) http://lib.dvfu.ru:8080/lib/item?id=chamo:353962&theme=FEFU

3. Change in the chemical composition of grain products during germination / N. K. Kazyonnova, D. V. Schneider, I. V. Kazyonnov // Bakery products: monthly scientific, technical and industrial journal. - 2013. - No. 10. - S. 55-57. Source of article (VRT) 000418748. http://lib.dvfu.ru:8080/lib/item?id=chamo:715798&theme=FEFU

4. The use of proteolytic enzymes to increase the degree of extraction of protein compounds of sunflower meal / D. V. Baurin [et al.] // Storage and processing of agricultural raw materials: theoretical journal. - 2014. - No. 10. - S. 16-20. Source of article (VRT) 000425845. http://lib.dvfu.ru:8080/lib/item?id=chamo:754177&theme=FEFU

5. Microbial oxidation of a mixture of used oils in a liquid medium / D. A. Filatov [et al.] // Biotechnology: Theoretical and Scientific-Practical Journal. - 2013. - No. 6. - S. 57-64. Source of article (VRT) 000252550. http://lib.dvfu.ru:8080/lib/item?id=chamo:719178&theme=FEFU

6. Obtaining ethanol from returnable baking waste. Part 1. Wort production / M. E. Sidyakin, L. N. Krikunova // Storage and processing of agricultural raw materials: theoretical journal. - 2012. - No. 12. - S. 33-37. Source of article (VRT) 000425845. http://lib.dvfu.ru:8080/lib/item?id=chamo:678911&theme=FEFU

7. Factors affecting mass transfer processes during storage of fruit and vegetable raw materials / N. G. Shcheglov // Storage and processing of agricultural raw materials: theoretical journal. - 2014. - No. 3. - S. 15-18. Source of article (VRT) 000425845. http://lib.dvfu.ru:8080/lib/item?id=chamo:719151&theme=FEFU

8. Gamayurova V.S. Enzymes [Electronic resource]: laboratory workshop. Textbook / Gamayurova V.S., Zinoviev M.E. - The electron. text data. - St. Petersburg: Prospect of Science, 2017 .-- 256 c. - Access mode: http://www.iprbookshop.ru/35819

9. The basics of biotechnology [Electronic resource]: textbook / A.Yu. Prosekov [et al.]. - The electron. text data. - Kemerovo: Kemerovo Technological Institute of Food Industry, 2015. - 214 c. - Access mode: http://www.iprbookshop.ru/61271.html.

8. METHODOLOGICAL INSTRUCTIONS FOR THE DEVELOPMENT OF THE DISCIPLINE

The theoretical part of the discipline "Enzymatic and microbial conversion" is revealed at the lecture classes, as a lecture is the main form of training, where the teacher gives the basic concepts of the discipline.

The sequence of presentation of the material at the lecture classes is aimed at forming an indicative basis for students for the subsequent assimilation of the material during independent work.

In practical exercises during discussions at seminars and in discussing essays, students learn to analyze and predict the development of biotechnology in various applications as a science, and reveal its scientific and social problems.

Practical classes of the course are held in all sections of the curriculum. Practical work is aimed at developing students' independent research work skills. During practical classes, the student performs a set of tasks that allows you to consolidate lecture material on the topic under study, to obtain basic skills in various fields of biotechnology. The active consolidation of theoretical knowledge is facilitated by the discussion of the problematic aspects of the discipline in the form of a seminar and practical exercises. At the same time, the skills of independent research activity are developed in the process of working with scientific literature, periodicals, the formation of the ability to defend one's point of view reasonably, listen to others, answer questions, and lead a discussion.

When writing essays, it is recommended that you independently find the literature for it. The abstract reveals the content of the investigated problem. Work on the essay helps to deepen understanding of individual issues of the course, to

form and defend your point of view, to acquire and improve independent creative work skills, to conduct active cognitive work.

The main types of independent work of undergraduates is work with literary sources and methodological recommendations for studying the bioconversion technology of plant and animal raw materials, Internet resources for a deeper familiarization with individual problems of bioconversion technology. The results of the work are drawn up in the form of abstracts or reports with subsequent discussion. Topics of essays correspond to the main sections of the course.

To conduct ongoing monitoring and intermediate certification, several oral interviews and test-control works are carried out.

9. MATERIAL AND TECHNICAL SUPPORT OF DISCIPLINE

Logistical support for the implementation of the discipline includes classrooms for lectures and practical exercises, equipped with multimedia equipment, and corresponding to sanitary and fire safety standards.

Logistics of the discipline

Name of equipped premises	List of main equipment
Vladivostok, Russian Island, 10 Ajax, Building 25.1, aud. M425. The classroom for lectures, practical and laboratory classes, group and individual consultations, ongoing monitoring and interim certification	Laboratory of Problems of Quality and Food Safety. Training furniture for 26 workplaces, teacher's place (table, chair). Analytical and technological equipment (M425): water thermostat T-250; monocular microscope. microscope chamber, GP-80 SPU sterilizer, Ocean-4 refrigerator, scales, bactericidal irradiator OBN 150 2x30 wall AZOV (set) 101-230472, 10 Biomed microscope, SKM-1 microorganism colony counter, 111CH electric dream plate 101-226589; PE-6110 magnetic stirrer with heating
Computer class Vladivostok, Russian Island, Ajax d.10, Building 25.1, aud. M612. The classroom for practical and laboratory studies of group and individual consultations, current monitoring and intermediate certification.	Training furniture for 22 jobs. Teacher's place (table, chair). HP All-in-One HP ProOne 400 G1 AiO 19.5 "Intel Core i3-4160T 4GB DDR3-1600 SODIMM (1x4GB) 500GB Windows Seven Enterprise - 22 pcs; Wired LAN - Cisco 800 series; Wireless LAN for students with a system based on 802.11a / b / g / n 2x2 MIMO (2SS)
Independent work	
Computer class	Computer class.

Vladivostok, Russian Island, 10 Ajax, Building 25.1, aud. M621 Area 44.5 m2 The classroom for practical and laboratory studies of group and individual consultations, current monitoring and intermediate certification	Training furniture for 17 workplaces, teacher's place (table, chair), Monoblock Lenovo C360G-i34164G500UDK 19.5 "Intel Core i3-4160T 4GB DDR3-1600 SODIMM (1x4GB) 500GB Windows Seven Enterprise - 17 pcs; Wired LAN - Cisco 800 series; Wireless LAN for students with a system based on 802.11a / b access points / g / n 2x2 MIMO (2SS).
Reading rooms of the FEFU Scientific Library with open access to the fund (building A - level 10)	Reading room equipment for the FEFU Scientific Library: HP All-in-One 400 All-in-One Monoblock 400 All-in-One 19.5 (1600x900), Core i3-4150T, 4GB DDR3-1600 (1x4GB), 1TB HDD 7200 SATA, DVD +/- RW, GigEth, Wi- Fi, BT, usb kbd / mse, Win7Pro (64-bit) + Win8.1Pro (64-bit), 1-1-1 Wty Internet access speed of 500 Mbps. Workplaces for people with disabilities are equipped with braille displays and printers; equipped with: portable devices for reading flat-printed texts, scanning and reading machines with a video enlarger with the ability to control color spectra; magnifying electronic magnifiers and ultrasonic markers

10.VALUATION FUNDS

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)	
SPC-14 the ability to use standard and develop new methods for engineering calculations of technological parameters and equipment for biotechnological production	Knows	typical and new methods of engineering calculations of technological parameters and equipment of biotechnological productions
	Can	use standard and develop new methods for engineering calculations of technological parameters and equipment for biotechnological production
	Owns	skills in using standard and developing new methods for engineering calculations of technological parameters and equipment for biotechnological production
SPC-17 readiness for pilot testing of technology and scaling of processes	Knows	pilot testing of technology and scaling of processes
	Can	conduct pilot testing of technology and scaling of processes
	Owns	skills in conducting pilot testing of technology and scaling up processes
SPC-19 the ability to analyze the indicators of the technological process for compliance with the original scientific developments	Knows	analysis of process indicators for compliance with initial scientific developments
	Can	analyze the indicators of the technological process for compliance with the original scientific developments
	Owns	the skills of analyzing the indicators of the technological process for compliance with the original scientific developments

Interim certification includes the student's answer to the questions for the exam and passing the final test.

Student Examination Criteria

Points (rating)	Credit / exam grade (standard)	Requirements for formed competencies
100-85	"Credit" / "excellent"	The student is rated as “excellent” if he has deeply and firmly grasped the program material, sets out comprehensively, consistently, clearly and logically in harmony with him, knows how to closely relate theory to practice, freely copes with tasks, questions and other types of application of knowledge, and does not the answer when modifying tasks, uses monographic material in the answer literature, correctly substantiates the decision, owns versatile skills and techniques for performing practical tasks.
84-75	"Credit" / "good"	The student is rated “good” if he knows the material well, correctly and essentially sets out it, avoiding significant inaccuracies in answering the question, correctly applies theoretical principles when solving practical questions and tasks, and has the necessary skills and techniques for their implementation
74-61	"Credit" / "satisfactory"	A student is rated “satisfactory” if he has knowledge of only the main material, but has not learned its details, admits inaccuracies, insufficiently correct wording, disruptions in the logical sequence in the presentation of program material, and has difficulty performing practical work.
60-0	"Not credited" / "unsatisfactory"	Evaluation of "unsatisfactory" is given to a student who does not know a significant part of the program material, makes significant errors, hesitates, with great difficulty performs practical work. Typically, grades are given to students who cannot continue their studies without additional classes in the relevant discipline.

Tasks for self-fulfillment

1. On a given topic of the round table should be an analysis of the literature on the studied discipline.

2. Writing an essay on a topic proposed by the teacher or independently selected by the student and agreed with the teacher.

3. Preparation of presentations using multimedia equipment.

Methodological instructions for the implementation of the essay

The goals and objectives of the essay

The essay(from lat. Referto - report, report) is a summary of the problems of a practical or theoretical nature with the formulation of certain conclusions on the subject. A student-selected problem is studied and analyzed based on one or more sources. In contrast to the term paper, which is a comprehensive study of the problem, the essay is aimed at analyzing one or more scientific papers.

The objectives of writing an essay are:

development of students' skills in finding relevant problems of modern legislation;

• development of skills to summarize the material with highlighting only the most significant points necessary to reveal the essence of the problem;

• development of skills to analyze the material studied and formulate their own conclusions on the selected issue in writing, in a scientific, competent language.

The tasks of writing an essay are*:*

- teach the student to convey the opinions of the authors as faithfully as possible, on the basis of which the student writes his essay;
- teach the student to correctly state their position on the problem analyzed in the abstract;
- prepare the student for further participation in scientific - practical conferences, seminars and competitions;
- help the student to determine the topic of interest to him, the further disclosure of which is possible when writing a term paper or diploma;
- to clarify for themselves and state the reasons for their consent (disagreement) with the opinion of one or another author on this issue.

The basic requirements for the content of the essay, course project

The student should use only those materials (scientific articles, monographs, manuals) that are directly related to their chosen topic. Remote reasoning not

related to the problem being analyzed is not allowed. The content of the essay should be specific, only one problem should be investigated (several are allowed, only if they are interconnected). The student must strictly adhere to the logic of presentation (start with the definition and analysis of concepts, go to the problem statement, analyze the ways to solve it and draw the appropriate conclusions). The essay should end with a conclusion on the topic.

The structure of the abstract consists of:

1. The title page;

2. Introduction, where the student formulates the problem to be analyzed and investigated;

3. The main text, which consistently reveals the selected topic. Unlike term paper, the main text of the essay involves a division into 2-3 paragraphs without highlighting the chapters. If necessary, the text of the abstract can be supplemented by illustrations, tables, graphs, but they should not "overload" the text;

4. Conclusions, where the student formulates conclusions made on the basis of the main text.

5. The list of used literature. This list refers to those sources that the student refers to in preparing the essay, as well as others that were studied by him during the preparation of the essay.

The essay is 10-15 pages of typewritten text, but in any case should not exceed 15 pages. Interval - 1.5, font size - 14, margins: left - 3 cm, right - 1.5 cm, upper and lower - 1.5 cm. Pages must be numbered. The indent from the beginning of the line is 1.25 cm.

The order of delivery of the essay and its assessment

Essays are written by students during the semester in the terms set by the teacher in a particular discipline, reported by the student and submitted for discussion. The printed version is given to the teacher, leading the discipline.

Based on the results of the check, the student is given a certain number of points, which is included in the total number of student points scored by him

during the semester. When evaluating the essay, the correspondence of the content to the chosen topic, the clarity of the work structure, the ability to work with scientific literature, the ability to pose a problem and analyze it, the ability to think logically, knowledge of professional terminology, and literacy are taken into account.

Recommended topics and list of essays

1. Amylases and their use in the processing of raw materials.
2. Cellulases and their use in the processing of raw materials.
3. Pectinases and their use in the processing of raw materials.
4. Proteolytic enzymes and their use in the processing of raw materials.
5. Sources and ways of using carbon dioxide in bioconversion production.
6. Production of edible ethyl alcohol.
7. Production of technical ethyl alcohol.
8. Primary and secondary sources of raw materials for bioconversion.
9. The structure of enzymes.
10. Coenzymes and cofactors.
11. Activators and inhibitors of enzymes.
12. Products obtained by bioconversion.
13. Products obtained by microbiological bioconversion of plant materials.
14. Hydrolytic and redox enzymes of raw materials.
15. Enzymes associated microflora raw materials.
16. Enzyme preparations of plant origin.
17. Enzyme preparations of microbial origin.
18. Enzyme preparations of animal origin.
19. Enzyme systems of cultural strains of microorganisms causing fermentation.
20. Enzyme systems of cultural strains of microorganisms that cause fermentation, producers of organic acids, amino acids, vitamins, enzymes, food protein.

Questions for the exam

1. The concept of conversion and bioconversion. Types of bioconversion.
2. Technology of bioconversion of plant materials to glycerin.
3. Waste-free technologies for the use of plant materials.
4. The technology of bioconversion of plant materials into acetic acid.
5. Methods of bioconversion of raw materials of plant origin.
6. The technology of bioconversion of plant materials into citric acid.
7. Bioconversion of carbohydrate-containing raw materials.
8. Obtaining dietary supplements by the conversion of plant materials.
9. Bioconversion of low molecular weight biologically active substances.
10. Types of conversion and bioconversion. Direct bioconversion.
11. Micro and macroorganisms involved in bioconversion.
12. Plant materials used in bioconversion. Types, application.
13. Enzymes and enzyme preparations used in bioconversion of plant materials.
14. Enhanced bioconversion. Definition, types, application.
15. Pretreatment of plant materials. Purpose, types of pre-treatment.
16. Technology of bioconversion of plant materials to isopropanol.
17. Environmental aspects of the rational use of plant resources.
18. Bioconversion of lignocellulosic waste.
19. Wastes of production: definition, scientific and technical solutions for the disposal of industrial wastes.
20. Waste-free processing cycle of agricultural raw materials.
21. Integrated use of natural resources and technological waste.
22. Technologies for bioconversion of plant materials into biologically valuable products of microbiological synthesis.
23. Waste as a source of food, feed and fertilizer.
24. Technology of bioconversion of plant materials to acetone.
25. Types of carbohydrate-containing raw materials used in bioconversion.

26. Protein bioconversion.

27. Polysaccharide-containing raw materials used in bioconversion.

28. Bioconversion of lipids.

29. Wastes from the forestry and forestry industries used for bioconversion.

30. Production of bioethanol using starch-containing raw materials.

31. Algae, microalgae, as sources for the production of renewable energy resources.

32. Wastes from the processing of plant materials containing starch.

33. Methyl alcohol, glycerin as the main products of processing vegetable oil into biodiesel.

34. Sources of feed protein. Creation problems, solutions.

35. Wastes from plant materials as sources of mono-, di- and oligosaccharides and their bioconversion technologies.

36. The use of new bacterial preparations based on osmotolerant strains of lactic acid and other bacteria.

37. Sources of plant materials for the production and accumulation of protein material.

38. The integrated use of technological methods for obtaining feed raw materials.

39. Media for the production of protein from microorganisms.

40. Bioconversion of vegetable oil into biological diesel fuel.

41. Technology and equipment for the production of biodiesel.

42. Lignin-lytic enzymes. Conducting enzymatic hydrolysis with their participation.

43. Bioconversion as a process of enrichment of plant materials with biologically active substances.

44. Bioconversion of plant materials by enzymes.

45. Bioconversion of toxins, poisons and pathogens for humans and animals from raw materials of plant origin into dosage forms.

46. The main chemical methods of conversion of plant materials.

47. Classification of methods for the conversion of plant materials.

48. Cellulolytic enzymes and their mechanism of action.

49. Amylolytic enzymes and their mechanism of action.

50. Bioconversion of clarified substrates from plant materials.

51. Hemicellulase enzyme preparations and their mechanism of action.

52. Hydrolysis of plant materials with concentrated acids.

53. Physical and combined methods of conversion of plant materials. Types, characteristics.

54. The mechanism and kinetics of the decomposition of monosaccharides.

55. Biological methods of conversion of plant materials. Types, a brief description.

56. The mechanism and kinetics of hydrolysis of polysaccharides of plant materials in a slightly acidic environment.

57. Enzymatic hydrolysis of plant materials.

58. Bioconversion of toxins, poisons and pathogens for humans and animals from raw materials of plant origin into biologically active substances.

59. Activity and substrate specificity of catalyst enzymes.

60. The main directions of improving waste-free production based on renewable plant materials.

61. Technology for the non-waste production of ethyl alcohol.

62. Preparation of plant materials for bioconversion.

63. Wastes from the production of hydrolytic ethyl alcohol, fodder yeast and ways of their disposal.

64. Direct bioconversion of plant materials by microorganisms.

65. Bioconversion of plant materials by enzymes and microorganisms.

66. Characterization of cellulose-containing and pentosan-containing raw materials used in biotechnological processes.

67. The anatomical structure of plant cells of cellulose-containing and pentosan-containing raw materials.

68. Technology of non-waste production of feed protein products.

69. The chemical composition of cellulose-containing and pentosan-containing raw materials.

70. Classification of the fermentation processes of microorganisms.

71. Sugar-containing raw materials used in biotechnological processes.

72. Sources of cellulose-containing and pentosan-containing raw materials used in biotechnological processes

FINAL TEST

VARIANT 1

1. Bioconversion is:

a) the conversion of some organic compounds to others due to the influence of chemical inorganic substances on the feedstock;

b) the conversion of some organic compounds to others due to the action of the enzyme systems of microorganisms;

c) the conversion of some organic compounds to others due to exposure to hormonal preparations of animal origin;

d) the conversion of some organic compounds to others due to exposure to physical environmental factors.

2. The main products obtained by microbiological bioconversion of plant materials:

a) vitamin preparations;

b) rubber;

c) proteinized feed;

d) liposomal fractions.

3. The main sources of raw materials for bioconversion are:

a) waste from the metallurgical industry;

b) aircraft instrumentation waste;

c) raw materials and waste of the food industry;

d) waste from the chemical industry.

4. The ripening processes of wheat flour are characterized by:

a) an increase in acidity due to the decomposition of fat and the accumulation of protein hydrolysis products;

b) darkening of color as a result of oxidation of carotenoids;

c) the absence of changes in the readings of moisture content of flour;

d) a decrease in the structural and mechanical properties of gluten.

5. Enzymes are catalysts:

a) protein nature;

b) carbohydrate nature;

c) lipid nature;

d) inorganic nature

6. Enzymes are chemicals that:

a) not affected by pH;

b) do not affect the rate of biochemical reactions;

c) are not affected by temperature;

d) accelerate the course of biochemical reactions.

7. Denaturation of the enzyme causes:

a) the presence in the reaction medium of vitamin K;

b) neutral pH values;

c) high temperature of the reaction medium;

d) the presence of dipeptides in the reaction medium.

8. Hydrolases are a class of enzymes that catalyze:

a) reaction of the splitting of polymers without the participation of water;

b) redox reactions;

C) reactions of the splitting of polymers with the participation of water;

d) the biosynthesis of organic substances.

9. The following organic matter belongs to the class of hydrolase enzymes:

a) glucose;

b) glycerin;

c) α-amylase;

d) benzoic acid.

10. The enzyme α-amylase accelerates the hydrolysis reaction:

a) phospholipids;

b) starch;

c) myosin;

d) nucleic acid.

VARIANT 2

1. Cellulase accelerates hydrolysis reactions:

a) phospholipids;

b) myosin protein;

c) cellulose;

d) nucleic acid.

2. The protease enzyme accelerates the hydrolysis reaction:

a) phospholipids;

b) starch;

c) nucleic acid;

d) protein and peptides.

3. The enzyme pectinase accelerates the hydrolysis reaction:

a) phospholipids;

b) myosin protein;

c) the structural component of the cell wall of pectin plants;

d) nucleic acid.

4. The main secondary sources of raw materials for bioconversion are waste:

a) the metallurgical industry;

b) aircraft instrumentation;

c) agricultural production;

d) chemical industry.

5. The following microorganisms are used in the production of bakery products:

a) mold fungi;

b) blue-green algae;

c) yeast;

d) bacteriophages.

6. The following microorganisms are used in the production of bakery products:

a) mold fungi;

b) blue-green algae;

c) lactic acid bacteria;

d) bacteriophages.

7. The maturation of the test includes the following processes:

a) alcohol fermentation;

b) propionic acid fermentation;

c) decay;

d) photosynthesis.

8. The maturation of the test includes the following processes:

a) propionic acid fermentation;

b) decay;

c) photosynthesis;

d) lactic acid fermentation.

9. The fermentation process of the dough (bread) stops at a baking temperature:

a) + 25 ° C;

b) + 40 ° C;

c) + 50 ° C;

d) + 80 ° C.

10. The life process of acid-forming bacteria is suspended at a baking temperature:

a) + 25 ° C;

b) + 40 ° C;

c) + 60 ° C;

d) + 80 ° C.

VARIANT 3

1. The chemical process that occurs when baking bread:

a) denaturation of plant proteins;

b) carbohydrate synthesis;

c) ATP synthesis;

d) the breakdown of glycogen.

2. The colloidal process that occurs when baking bread:

a) the synthesis of carbohydrates;

b) ATP synthesis;

c) the breakdown of glycogen;

d) gelatinization of starch.

3. For the production of food ethyl alcohol, the following raw materials are used:

a) waste wood industry;

b) raspberry syrup;

c) grain cereals;

d) the waste of the oil industry.

4. Amylolytic enzyme complex is used in the production of ethyl alcohol for:

a) cooling the feedstock;

b) hydrolysis of starch and non-starch polysaccharides contained in the feedstock into fermentable sugars;

c) protein synthesis;

d) splitting of fatty acids.

5. Amylolytic enzyme complex is used in the production of ethyl alcohol at the following technological stage of processing of raw materials:

a) storage of raw materials;

b) the purchase of raw materials;

c) boiling and saccharification of raw materials;

d) fermentation of raw materials.

6. Yeast is used in the production of ethyl alcohol at the following technological stage:

a) storage of raw materials;

b) the purchase of raw materials;

c) boiling and saccharification of raw materials;

d) fermentation of saccharified wort.

7. To obtain beer wort from mixed raw materials, mainly enzymes of the class are used:

a) hydrolases (amylases, proteases);

b) isomerase;

c) lyase;

d) transferases.

8. The following microorganisms are used to ferment beer wort:

a) bacteriophages;

b) protozoa;

c) yeast;

d) bacteria.

9. Grain wastes of alcohol and brewing production are used for:

a) the preparation of therapeutic drugs;

b) methane biogas production;

c) wastewater treatment;

d) for livestock feed.

10. Residual yeast, which is a waste of alcohol and brewing production, is used for:

a) preparation of enzyme preparations;

b) methane biogas production;

c) wastewater treatment;

d) irrigation of pastures.

VARIANT 4

1. Carbon dioxide released during the production of ethyl alcohol and beer is used for:

a) the preparation of therapeutic drugs;

b) preparation of dry ice;

c) wastewater treatment;

d) for fertilizers.

2. For the fermentation of fruit wort, the following microorganisms are used:

a) bacteriophages;

b) protozoa;

c) bacteria;

d) yeast.

3. The processing of wine by the hydrolytic enzyme preparation Vinozim is used for:

a) lowering the color intensity;

b) an increase in the number of polysaccharides;

c) clarification of the wort;

d) lowering the yield of extractive substances.

4. Processing of wine with a hydrolytic enzyme preparation, an acidic protease is used for:

a) lowering the color intensity;

b) an increase in the number of polysaccharides;

c) clarification of the wort;

d) stabilization of wine from colloidal turbidity.

5. Fermentation of fruit drinks with hydrolytic enzymes is carried out with the aim of:

a) reducing the number of colloids in solution;

b) reducing the amount of vitamin C in solution;

c) increasing the viscosity of the solution;

d) protect solutions from exposure to UV rays.

6. Fermentation of chokeberry berries Cellulase-100 in the production of anthocyanin dye is used for:

a) lowering the concentration of vitamin C;

b) increase the yield of anthocyanins, followed by water-alcohol extraction;

c) reducing the rate of extraction of anthocyanins;

d) protecting plant cells from exposure to radiation.

7. Tea leaf treatment with the hydrolytic enzyme preparation Cellolignorin P10x is used for:

a) protect plant cells from exposure to UV rays;

b) reducing the number of amino acids;

c) increasing the amount of unsaturated fatty acids;

d) increasing the number of extractive substances.

8. Tea leaf treatment with the phenol oxidase enzyme preparation (oxidoreductase class) is used for:

a) protect plant cells from exposure to UV rays;

b) reducing the number of amino acids;

c) reducing the time of fermentation of the tea leaf;

d) increasing the number of extractive substances.

9. Saturation of drinks is a technological process:

a) corking of finished products;

b) saturation of drinks with carbon dioxide;

c) dosing blend syrup in bottles;

d) mixing the contents of the bottle.

10. Yeast and ground precipitation, which is a waste of winemaking and juice production, is used for:

a) the preparation of feed flour and granular feed;

b) methane biogas production;

c) wastewater treatment;

d) irrigation of pastures.

II. Evaluation tools for ongoing certification

Evaluation Criteria

- 100-86 points are awarded to the student if the student expressed his opinion on the formulated problem, argued for it, accurately determining its content and components. The data of domestic and foreign literature, statistical information, and regulatory information are presented. The student knows and possesses the skill of independent research work on the topic of research; methods and techniques of analysis of theoretical and / or practical aspects of the study area. There are no factual errors related to understanding the problem; graphically, the work is framed correctly

- 85-76 - points - the work is characterized by semantic integrity, coherence and sequence of presentation; no more than 1 mistake was made in explaining the meaning or content of the problem. For argumentation, data from domestic and foreign authors are given. Demonstrated research skills. There are no actual errors related to understanding the problem. One or two errors in the design of the work

- 75-61 points - the student conducts a fairly independent analysis of the main stages and semantic components of the problem; understands the basic foundations and theoretical justification of the chosen topic. The main sources on this topic were brought. No more than 2 errors were made in the meaning or content of the problem, the design of the work

- 60-50 points - if the work is a retransmitted or completely rewritten source text without any comments, analysis. The structure and theoretical component of the topic is not disclosed. Three or more than three errors were made in the semantic content of the problem being revealed and in the design of the work.

Questions for colloquiums, interviews on the discipline «Enzymatic and microbial conversion»

Section I. Plant and animal raw materials used in biotechnological processes

1. Cellulose-containing and pentosan-containing raw materials.

2. Starch-containing raw materials. Sugar-containing raw materials.

3. The concept of conversion and bioconversion of plant and animal raw materials.

Section II. Methods for the conversion of plant and animal raw materials

1. Obtaining dietary supplements by the conversion of plant materials.

2. Physical and combined methods of conversion of plant and animal raw materials.

3. Chemical methods for the conversion of plant and animal raw materials.

4. Biological methods of conversion of plant and animal raw materials.

Evaluation Criteria

- 100-86 points are awarded to the student, if the student knows and is fluent in the material, expressed his opinion on the formulated problem, argued for it. For preparation, the student uses not only lecture material, but also additional domestic and foreign literature.

- 85-76 - points - the work is characterized by semantic integrity, coherence and sequence of presentation. There are no actual errors related to understanding the problem.

- 75-61 points - the student understands the basic foundations and theoretical justification of the topic. The main sources on this topic were brought.

- 60-50 points - if the answer is a retransmitted source text, without any comments, analysis. Three or more than three errors were made in the semantic content of the topic.